Cover Sheet (NOAA Form 76-35A)

NOAA FORM 76-35A

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

Data Acquisition and Processing Report

Type of Survey HYDROGRAPHIC

Field No M-M928-KR-09

Registry No. H12130 & H12131

LOCALITY

State CALIFORNIA

General Locality Pacific Ocean – Southern Oregon

Sublocality Areas Extending from Crook Point to Winchuck River

2010

CHIEF OF PARTY

DEAN MOYLES

LIBRARY & ARCHIVES

DATE

☆U.S. GOV. PRINTING OFFICE: 1985—566-054

Title Sheet (NOAA Form 77-28)

NOAA FORM 77-28 (11-72) U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION **HYDROGRAPHIC TITLE SHEET**	REGISTER NO. H12130 & H12131
INSTRUCTIONS – The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office	FIELD NO.

State OREGON

General Locality Pacific Ocean – Southern Oregon

Locality Areas Extending from Crook Point to Winchuck River

Scale NA Date of Survey 09/21/09 – 11/01/09

Instructions dated July 29, 2009 Project No. M-M928-KR-09

Vessel F/V PACIFIC STAR (556510), R/V R2 (623241), R/V D2 (647782)

Chief of party DEAN MOYLES

Surveyed by BRIGGS, MOYLES, REYNOLDS, FARLEY, ROKYTA, LYDON, LOPEZ, BARROW, TIXIER, GOODALL, CAIN, ESPOSITO,et. al.

Soundings taken by echo sounder, hand lead, pole RESON SEABAT 7125 (R2, PACIFIC STAR, HULL MOUNT), RESON SEABAT 8125 (D2, HULL MOUNT)

Graphic record scaled by FUGRO PELAGOS, INC. PERSONNEL

Graphic record checked by FUGRO PELAGOS, INC. PERSONNEL

Protracted by N/A Automated plot by N/A

Verification by

Soundings in METERS at MLLW

REMARKS: The purpose of this work is to provide NOAA with modern and accurate hydrographic survey data for the area in Southern Oregon from Crook Point to Winchuck River

ALL TIMES ARE RECORDED IN UTC.

FUGRO PELAGOS INC.

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A – Equipment

The F/V Pacific Star (with launches R2 and D2) acquired all sounding data for this project. The equipment list and vessel descriptions are included in Appendices I and II.

SOUNDING EQUIPMENT

F/V Pacific Star, 162 feet in length with a draft of 16 feet, was equipped with a hull mounted Reson SeaBat 7125 dual-frequency multibeam echosounder system for the M-M928-KR-09 survey. The Reson 7125 system operates at two user-selectable frequencies of 400 and 200 kHz. The system forms 256 or 512 beams at a spacing of 0.5° (across-track) in the 400 kHz mode, and 256 beams at a spacing of 1° (across-track) in the 200 kHz mode, with a maximum swath width of 128°. It allows the operator to select equi-angle or equi-distant beam spacing. For this project, both the 400 kHz and 200 kHz systems were configured for 256 equi-angle beams. The selection of these frequencies as well as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (see Separate 1). All 7125 multibeam data files were logged in the S7K format using WinFrog Multibeam v 3.08.44.04. The vessel was equipped with two AML sound velocity and pressure sensors (SV&P), and a Brooks Ocean Moving Vessel Profiler (MVP), for sound velocity profiles. Vessel attitude and position were measured using an Applanix Position and Orientation System for Marine Vessels (POS MV) 320 V4.

R/V R2, a Pacific Star launch, is 29 feet in length with a draft of 3 feet. For this survey, R2 was also equipped with a hull mounted Reson SeaBat 7125 dual-frequency multibeam echosounder. The Reson 7125 echosounder on R2 used the same configuration as on the F/V Pacific Star. All 7125 multibeam data files were logged in the S7K format using WinFrog Multibeam v 3.08.44.04. R2 was equipped with with two AML sound velocity and pressure sensors (SV&P) for sound velocity profiles, and vessel attitude and position were measured using an Applanix Position and Orientation System for Marine Vessels (POS MV) 320 V4.

R/V D2, a Pacific Star launch, is 29 feet in length with a draft of 3 feet. D2 is outfitted and configured in a manner very similar to R/V R2. For this survey, though, D2 was equipped with a Reson Seabat 8125 (455 kHz frequency) multibeam sonar system. The Reson 8125 system operates at a frequency of 455 kHz and forms 240 beams at a spacing of 0.5° (across-track), with a maximum swath coverage of 120°. Multibeam data files were logged in the XTF format using WinFrog Multibeam v 3.08.44.04. For sound velocity profiles, D2 was equipped with two AML (SV&P) probes. For measuring vessel attitude and position, D2 used the Applanix (POS MV) 320 V4.

The line orientation for all vessels was generally parallel to the coastline and bathymetric contours of the area. The line spacing was dependent on water depth and data quality, with an average line spacing of two to three times water depth.

The following table summarizes the sonar models and configurations used on each survey vessel.

Table 1 – Vessel Sonar Summary

Vessel Sonar Summary			
Vessel	**Pacific Star**	**R2**	**D2**
Mount Type	Hull	Hull	Hull
Sonar System(s)	Reson 7125 dual frequency	Reson 7125 dual frequency	Reson 8125
Operated in dual-head mode	No	No	No

SIDE SCAN SONAR

Towed Side Scan Sonar (SSS) operations were not required by this contract, but the backscatter and beam imagery snippet data from all multibeam systems were logged and are stored in the S7K files.

POSITIONING EQUIPMENT

All vessels were equipped with an Applanix Position and Orientation System for Marine Vessels (POS MV) 320 V4 to calculate position. Position was determined in real time using a Trimble Zephyr L1/L2 GPS antenna, which was connected to a Trimble BD950 L1/L2 GPS card residing in the POS MV. An Inertial Measurement Unit (IMU) provided velocity values to the POS MV allowing it to compute an inertial position based on DGPS, heading, and motion.

The POS MV was configured to accept differential corrections which were output from a CSI MBX-3 DGPS receiver that was tuned to the closest or strongest USCG DGPS station.

The POS MV controller software's real-time QC displays were monitored throughout the survey to ensure that the positional accuracies specified in the NOS Hydrographic Surveys Specifications and Deliverables were achieved. These include, but are not limited to the following: GPS Status, Position Accuracy, Receiver Status (which included HDOP), and Satellite Status.

SOFTWARE

Acquisition

All raw multibeam data for all vessels were collected with WinFrog Multibeam v3.08.44.04 (WFMB). WFMB ran on Windows XP Pro PCs with a dual-core Intel processor. Data from the 8125 sonar was logged in the XTF file format while data from the Reson 7125 sonars were logged in the S7K format. These XTF and S7K files contain all multibeam bathymetry, position, attitude, heading, and time stamp data required by CARIS to process the soundings. A separate WFMB module (PosMVLogger) on the same PC logged all raw POS MV data for post-processing of vessel position in Applanix POSPac software. WFMB also provided a coverage display for real time QC and coverage estimation of the acquired data.

WFMB offers the following display windows for operators to monitor data quality:

1. Devices: The Devices window shows the operator which hardware is attached to the PC. It also allows the operator to configure the devices, determine whether they are functioning properly, and to view received data.
2. Graphic: The Graphics window shows navigation information in plan view. This includes vessel position, survey lines, background vector plots, and raster charts.
3. Vehicle: The Vehicle window can be configured to show any tabular navigation information required. Typically, this window displays position, time, line name, heading, HDOP, speed over ground, distance to start of line, distance to end of line, and distance off line. Many other data items are selectable.
4. Calculation: The Calculations window is used to look at specific data items in tabular or graphical format. Operators look here to view the status of the GPS satellite constellation and position solutions.
5. MBES Coverage Map: The Coverage Map provides a real time graphical representation of the multibeam data. This allows the user to make judgments and corrections to your data collection procedure based on real conditions.
6. MBES QC View: The QC View contains four configurable windows for real time display of any of the following: 2D or 3D multibeam data, snippets, pseudo side scan or backscatter amplidue. In addition to this, it contains a surface sound speed utlity that is configurabe for real time SV monitoring.

Applanix POS MV V4 controller software was used to monitor the POS MV system. The software has various displays that allow the operator to check real time position, attitude and heading accuracies, and GPS status. POS MV configuration and calibration, when necessary, was also done using this program.

Fugro Pelagos' MB Survey Tools v2.00.25.00 was used to aid in file administration and reporting during data acquisition. This program created a daily file that contained survey line, SVP, and static draft records. These logs were stored digitally in a database format and later used to create the log sheets in PDF format located in Separate 1.

Processing

All Soundings were processed using CARIS (Computer Aided Resource Information System) HIPS (Hydrographic Information Processing System) v7.0. HIPS converted the XTF and S7K files to HIPS format, corrected soundings for sound velocity, motion, tide, and vessel offset, and was used to examine and reject noisy soundings. HIPS also produced the final BASE surfaces.

CARIS Notebook v3.1 was used to generate the S57 Feature Files.

ESRI ArcMap 9.3 was utilized for survey planning, reviewing coverage plots, creating fill-in and crosslines, and producing progress sketches.

Applanix POSPac MMS v5.3 was utilized for post-processing the vessel dual frequency GPS data with simultaneous base station data to calculate higher accuracy positions than those calculated in real time.

MB Survey Tools v2.00.25.00 was used to extract True Heave from POS files and put data into a text format acceptable to the CARIS Generic Data Parser. This was only utilized when the CARIS Load True Heave routine in HIPS failed to import.

MB Survey Tools allowed processors reviewing the data to track changes and add comments while processing. MB Survey Tools was also used to process all sound velocity profiles and put them into CARIS format.

A complete list of software and versions used on this project is included in Appendix I. Refer to the "2009-NOAA Processing Procedures" document for a detailed processing routine with procedures used.

B – Quality Control

Error estimates for all survey sensors were entered in the CARIS Hips Vessel File (HVF). These error estimates were used in CARIS to calculate the Total Propagated Uncertainty (TPU) at the 95% confidence interval for the horizontal and vertical components for each individual sounding. The values that were entered in the CARIS HVF for the survey sensors are the specified manufacturer accuracy values and were downloaded from the CARIS website **http://www.caris.com/tpu/**. The following is a breakdown and explanation on the manufacturer and Fugro Pelagos-derived values used in the error model:

- Navigation – A value of 0.10 m was entered for the positional accuracy. This value was selected since all positions were post processed, with all X, Y, and standard deviation values better than 0.10m.
- Gyro/Heading – All vessels were equipped with a (POS MV) 320 V4 and had a baseline < 4m, so therefore a value of 0.020 was entered in the HVF as per manufacturer specs.
- Heave – The heave percentage of amplitude was set to 5% and the Heave was set to

0.05m, as per manufacturer specs.

- Pitch and Roll - As per the manufacturer accuracy values, both were set to 0.02 degrees.
- Timing – All data were time stamped when created (not when logged) using a single clock/epoch (Pelagos Precise Timing method). Position, attitude (including TrueHeave), and heading were all time stamped in the POS MV on the UTC epoch. This UTC string was also sent to the Reson processor (8125 system), via a serial string (ZDA+1 PPS on 7125 systems), yielding timing accuracies on the order of 1 ms. Therefore a timing error of 0.001 seconds was entered for all sensors on all vessels.
- All vessel and sensor offsets were derived via conventional surveying techniques (total station), while the vessels were dry docked. The results yielded standard deviations of 0.005m to 0.010m, vessel and survey dependent.
- Vessel speed – set to 0.10 m/s since a POS MV with a 50 Hz output rate was in use.
- Loading – estimated vessel loading error set to 0.05m. This was the best estimate of how the measured static draft changed through the survey day.
- Draft – it was estimated that draft could be measured to within 0.01m to 0.05m, therefore values in this range were entered, vessel dependent.
- Tide error was set to 0.10 m. This value was selected since RMS for GPS altitude was typically better than this.
- Sound Speed Values were determined in MBTools, via the SVP Statistics utlity. This utility calculated the Mean, Variance, Standard Deviation and Min/Max values at a user specified depth interval.
- MRU Align StdDev for the Gyro and Roll/Pitch were set to 0.10° since this is the estimated misalignment between the IMU and the vessel reference frame.

The calculated vertical and horizontal error or TPU values were then used to create finalized CUBE (Combined Uncertainty Bathymetry Estimator) surfaces that used only soundings meeting or exceeding project accuracy specifications.

An overview of the data processing flow follows:

In order for the XTF and S7K files collected by WFMB to be used by CARIS, they must be converted to HDCS format using the CARIS XTF or ResonPDS converter routine. Prior to the files being converted, vessel offsets, patch test calibration values, TPU values, delta draft, and static draft were entered into the HVF.

Once converted, the SVP and TrueHeave data were loaded into each line and the line was SVP corrected in CARIS HIPS. The TPU was then computed for each sounding and the attitude, navigation, and bathymetry data for each individual line were examined for noise, as well as to ensure the completeness and correctness of the data set.

A filter settings file was formalized and named “60-012.hff”. This filter rejected all soundings falling greater than 60° from nadir, and soundings flagged as low quality by the Reson multibeam system. Note that “rejected” does not mean the sounding was deleted – it was instead flagged as bad so that it would not be included in subsequent processing, such as surface creation. Data flagged as rejected due to the angle from nadir parameters, did often contain valid

data but were flagged to remove noise and to speed the processing flow. Valid data were manually reaccepted into the data set occasionally during line and subset editing to fill data gaps.

Filter settings were often modified based upon data quality and sonar used, but all filter settings used were noted on each corresponding line log (refer to Separate 1).

Raw POS MV data logged in to a POS file were processed in conjunction with base station data in Applanix POSPac to produce an SBET (Smoothed Best Estimated Trajectory) file containing positioning data that was more accurate than the real time positioning data. These SBETs were loaded into each line in CARIS HIPS, which replaced the real time navigation data.

CUBE surfaces were then created at varying resolutions depending on the depth range. The following depth thresholds were used on this project.

- Depth Threshold: 0 to 23 meters resolution = 1 m
- Depth Threshold: 20 to 52 meters resolution = 2 m
- Depth Threshold: 46 to 115 meters resolution = 4 m

Deviations from these thresholds, if any, are detailed in the appropriate DR.

Subsets Tiles (to track areas examined) were then created in CARIS HIPS. Adjacent lines of data were examined to identify tidal busts, sound velocity and roll errors, as well as to reject any remaining noise in the data set that adversely affected the CUBE surface.

While examining the data in subset mode soundings were designated wherever the CUBE surface did not adequately depict the shoalest point of a feature. Soundings were designated when they met or exceeded the criteria for designation set forth in the Specifications and Deliverables. Designation ensured soundings were carried through to the finalized BASE surfaces.

A statistical analysis of the sounding data was conducted via the CARIS Quality Control Report (QCR) routine. Tie lines were run in each sheet and were compared with lines acquired from the main-scheme lines where applicable. The Quality Control Reports are located in Separate 4.

Sounding data that passed the required quality assurance checks were used in the final BASE surfaces. During final BASE surface creation in CARIS, the S-44 order option “Order 1” was selected, having values of a=0.5 and b=0.013. This constrained the area of influence of soundings to those that passed project specifications.

CARIS Notebook 3.1 was utilized to produce the S57 feature file. Seabed Area (SBDARE) polygon objects were picked from areas with obvious rocky bottom topography from the BASE surfaces. Meta-Coverage (M_COV) and Meta-Quality (M_QUAL) objects were defined as required using the extents of the multibeam BASE surfaces.

C - Corrections to Soundings

SOUND VELOCITY PROFILES

Sound velocity casts were normally performed every two hours. The AML Smart Probes used to determine sound velocities sampled at a rate of ten velocity and pressure observation pairs a second. For each cast, the probes were held at the surface for one to two minutes to achieve temperature equilibrium. The probes were then lowered and raised at a rate of 1 m/s. Between casts, the sound velocity sensors were stored in fresh water to minimize salt-water corrosion and to hold them at ambient water temperature.

A Brooks Ocean MVP-30 system was used on this project on the F/V Pacific Star. The system was used to collect a set of between three to five sound velocity profiles on a single line, then two hours later another set of profiles, to build a grid of sound velocity profiles. The MVP towfish (which utilized an AML Smart Probe) would free-fall rapidly to just off the seafloor and then be reeled in very slowly (about 0.5 m / second), producing most of its data on the up-cast. When not deployed, the towfish with sound velocity sensor was stored in fresh water to minimize salt-water corrosion and to hold it at ambient water temperature.

Fugro Pelagos' MB Survey Tools was used to check the profiles graphically for spikes or other anomalies and to produce an SVP file compatible with CARIS HIPS.

Refer to Appendix III for SVP Calibration Reports.

SETTLEMENT CURVE

Squat-settlement tests were performed on all vessels to obtain dynamic draft correctors.

The squat-settlement tests were performed by first establishing a 1000 meter line in the direction of the current. The survey vessel sat static at one end of the line for three minutes logging L1/L2 GPS data. The line was first run heading north at lowest possible engine RPM, then rerun heading south at the same RPM, stopping at the south end of the line to obtain an additional three minutes of static L1/L2 GPS data. This pattern was repeated for additional lines at incrementing vessel RPMs.

All measurements were corrected for heave, pitch, roll, and reduced to the vessel's common reference point (CRP). Static measurements observed at the end of each line set were used to compute a tide curve for tidal corrections. After post-processing with base station data in Applanix POSPac, a settlement curve of dynamic draft correctors was computed.

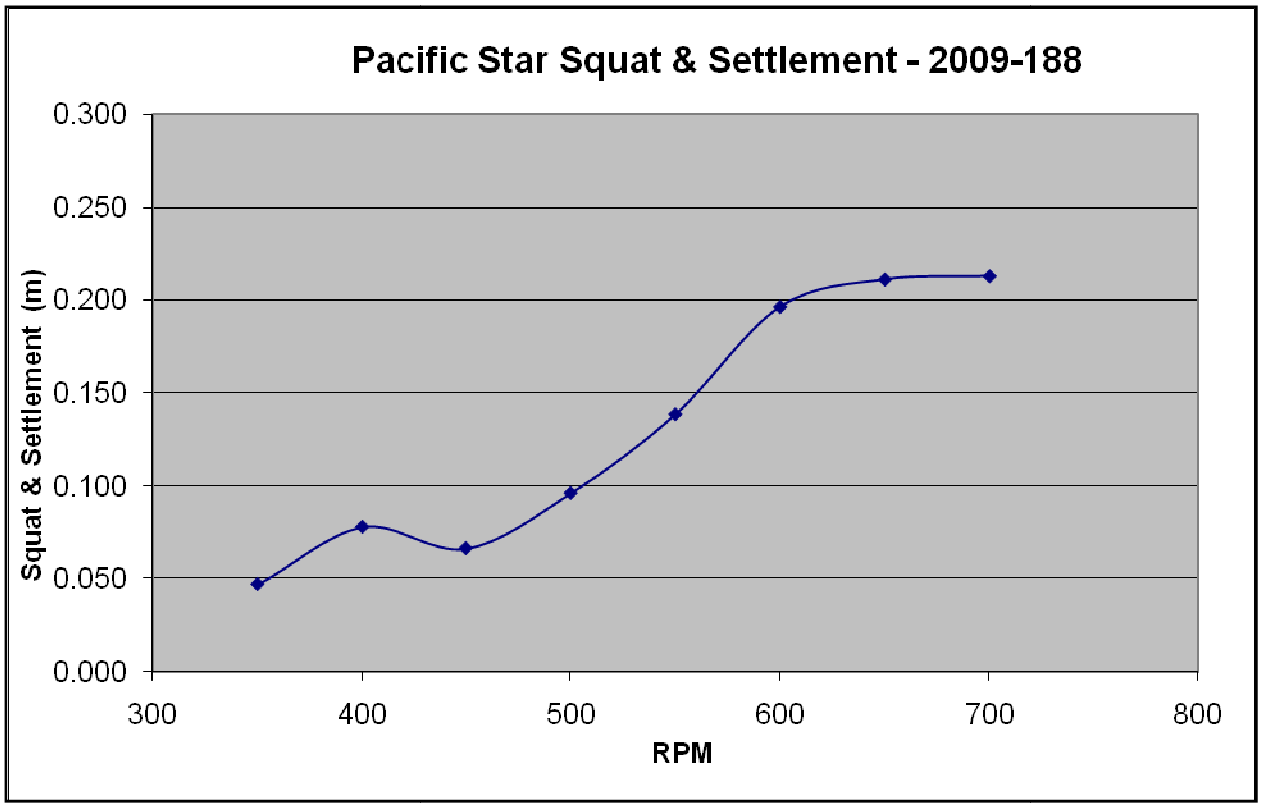


Figure 1 – Pacific Star Dynamic Draft

Table 2 – Pacific Star Squat Settlement Results

Pacific Star DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
5.2	350	0.047
6.7	450	0.066
7.4	500	0.096
8.1	550	0.138
8.9	600	0.196
9.5	650	0.211
10.1	700	0.213

The squat settlement test for the F/V Pacific Star was conducted near San Francisco, CA. on July 7, 2009 (Julian Day 188).

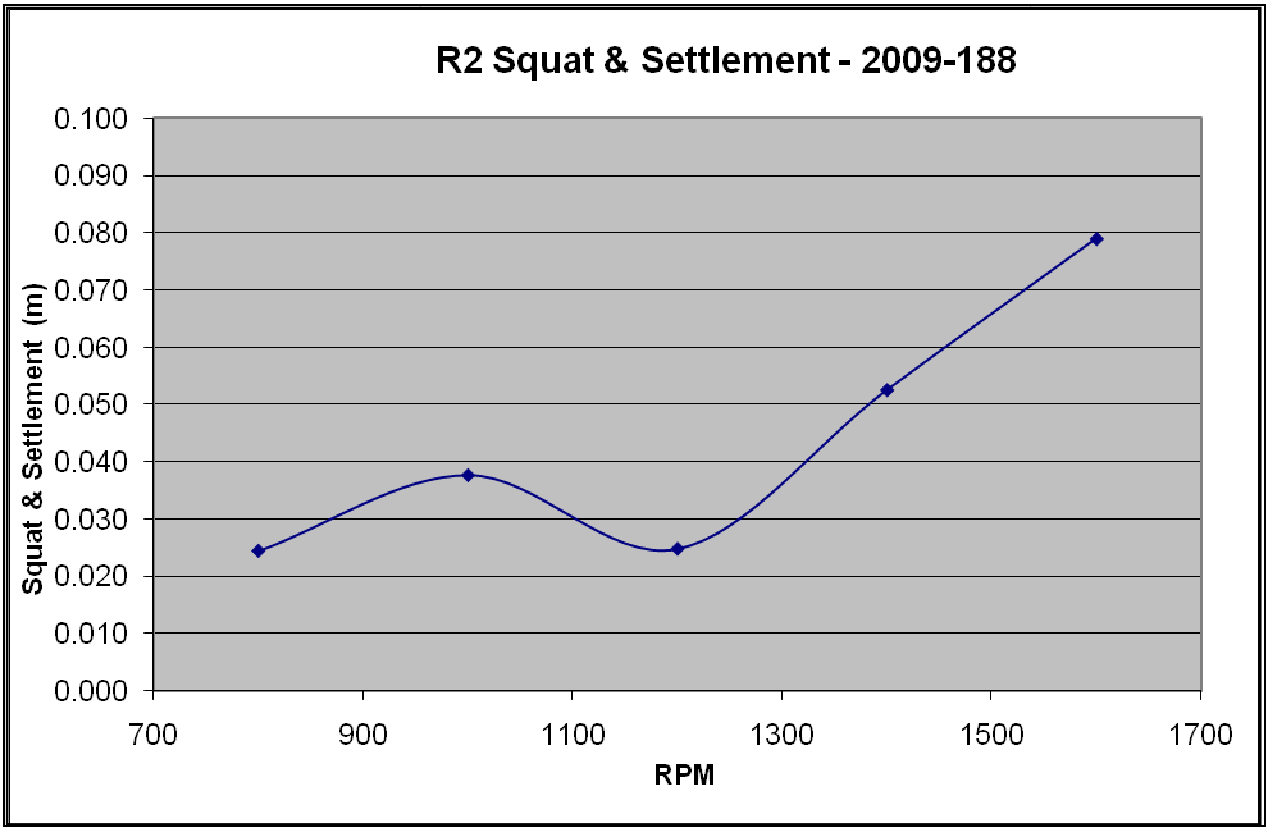


Figure 2– R2 Dynamic Draft

Table 3 – R2 Squat Settlement Results

R2 DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
4.1	800	0.025
4.9	1000	0.028
5.6	1200	0..025
6.3	1400	0.053
6.9	1600	0.079

The squat settlement test for the R/V R2 was conducted near San Francisco, CA. on July 7, 2009 (Julian Day 188).

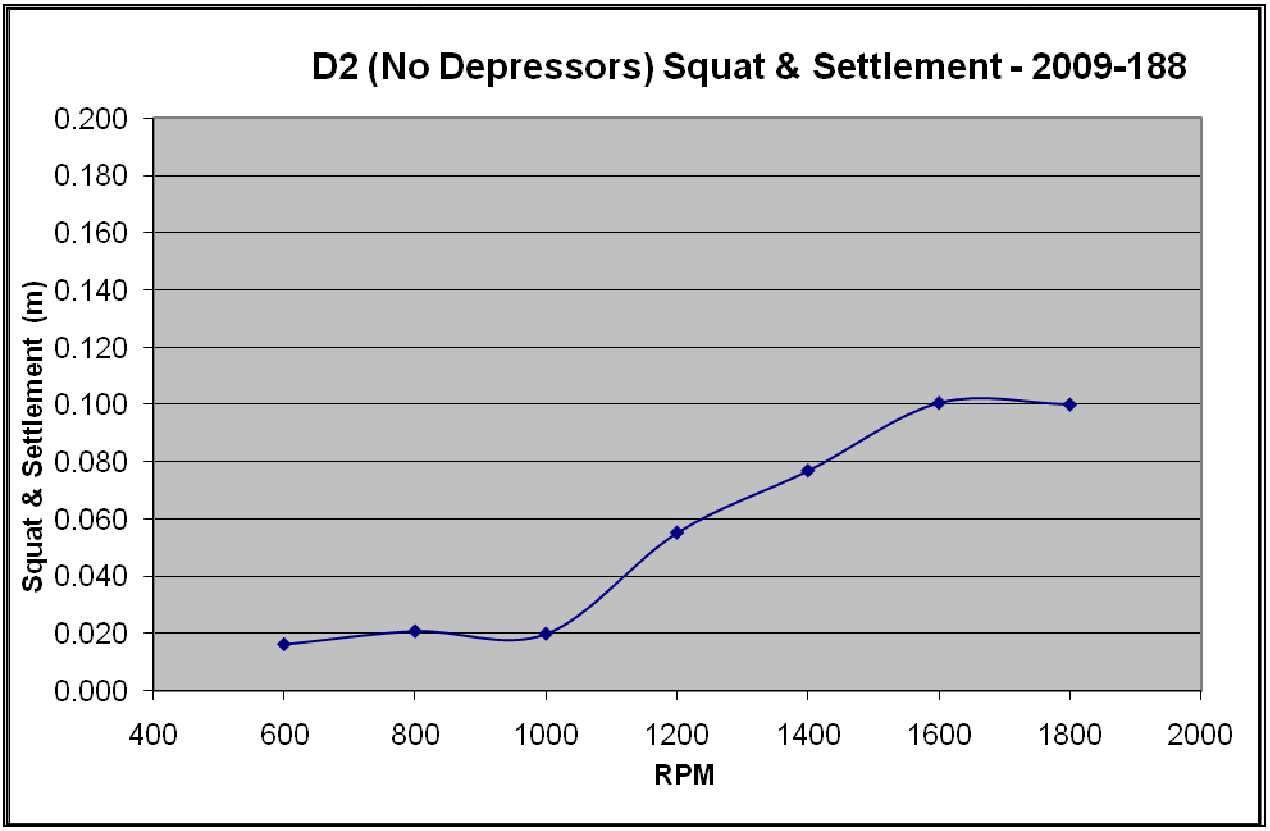


Figure 3 – D2 (No Depressors) Dynamic Draft

Table 4 – D2 (No Depressors) Squat Settlement Results

D2 DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
3.1	600	0.016
3.9	800	0.021
4.9	1000	0.020
5.6	1200	0.055
6.3	1400	0.077
6.7	1600	0.100
7.2	1800	0. 100

The squat settlement test for the R/V D2 was conducted near San Francisco, CA, on July 7, 2009 (Julian Day 188).

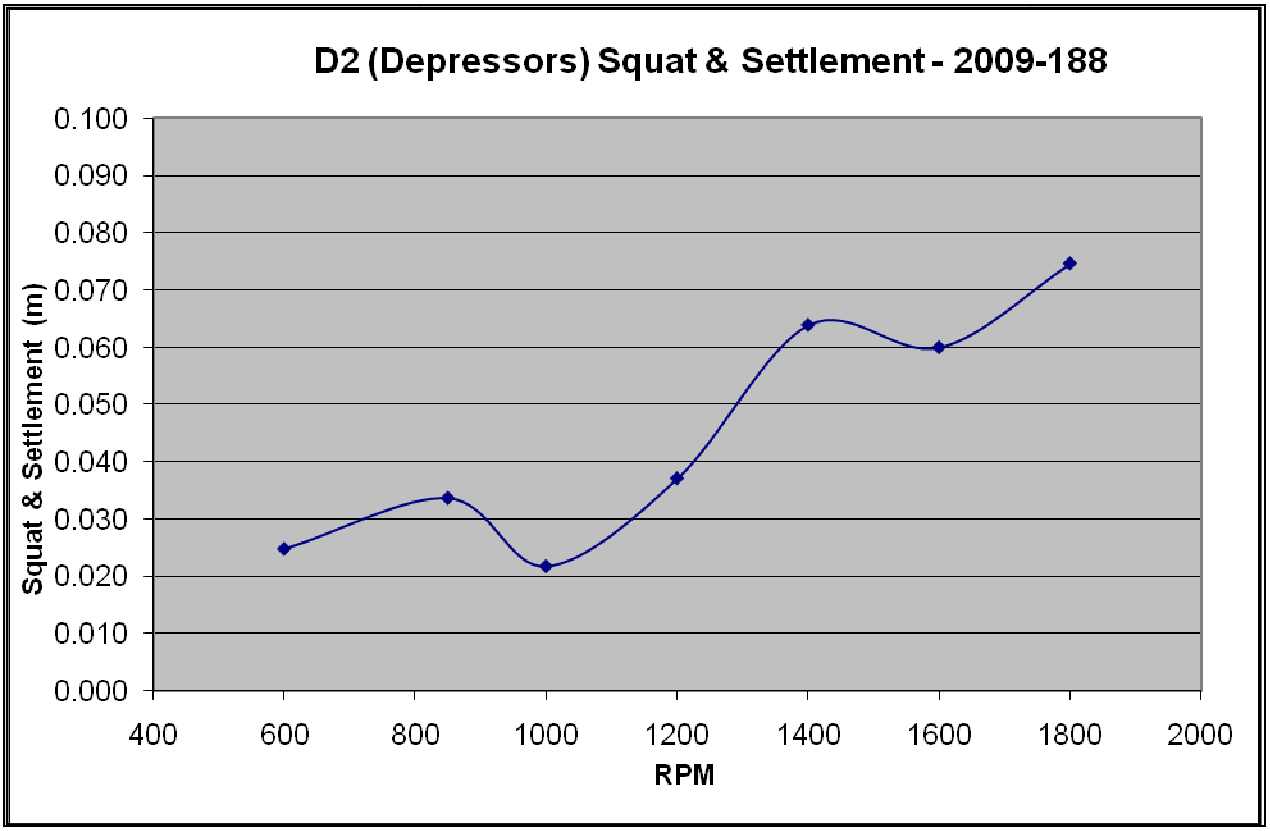


Figure 4 – D2 (Depressors) Dynamic Draft

Table 5 – D2 (Depressors) Squat Settlement Results

D2 DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
3.1	600	0.025
3.4	800	0.034
4.2	1000	0.022
4.9	1200	0.037
5.6	1400	0.064
6.3	1600	0.060
6.9	1800	0. 075

The squat settlement test for the R/V D2 was conducted near San Francisco, CA. on July 7, 2009 (Julian Day 188).

STATIC DRAFT

Static draft was measured from tabs on both sides of the vessel, the average was taken, and then the correction to the common reference point was applied. The tables below show the static draft values measured for all vessels.

Table 6 - Draft Measurements for the F/V Pacific Star

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
1	264	9/21/2009	15:21	-2.05
2	265	9/22/2009	1:48	-2.14
3	265	9/22/2009	15:10	-2.09
4	266	9/23/2009	1:46	-2.06
5	266	9/23/2009	14:24	-2.06
6	266	9/23/2009	19:04	-2.02
7	267	9/24/2009	1:48	-2.18
8	267	9/24/2009	14:22	-2.09
9	268	9/25/2009	1:58	-2.16
10	268	9/25/2009	14:29	-1.98
11	269	9/26/2009	1:41	-2.11
12	269	9/26/2009	14:18	-2.02
13	270	9/27/2009	0:11	-1.98
14	296	10/23/2009	15:05	-2.13
15	297	10/24/2009	1:24	-2.19
16	297	10/24/2009	14:40	-2.22
17	298	10/25/2009	1:11	-2.1
18	298	10/25/2009	14:42	-2.01
19	299	10/26/2009	1:13	-2.11
20	299	10/26/2009	14:56	-2.03
21	299	10/26/2009	18:58	-2.11
22	301	10/28/2009	14:52	-2.11
23	302	10/29/2009	1:09	-2.05
24	302	10/29/2009	14:51	-2.01
25	303	10/30/2009	14:48	-2.05
26	304	10/31/2009	1:05	-1.98
27	304	10/31/2009	14:53	-1.99
28	304	10/31/2009	20:26	-2.03
29	305	11/1/2009	14:40	-1.98
30	305	11/1/2009	20:43	-2.03

Table 7 - Draft Measurements for the R/V R2

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
1	264	9/21/2009	15:05	-0.27
2	265	9/22/2009	14:25	-0.25
3	266	9/23/2009	14:25	-0.23
4	267	9/24/2009	14:14	-0.25
5	268	9/25/2009	14:26	-0.24
6	269	9/26/2009	14:12	-0.24
7	296	10/23/2009	15:00	-0.24
8	297	10/24/2009	14:42	-0.23
9	298	10/25/2009	14:27	-0.23
10	299	10/26/2009	14:45	-0.23
11	301	10/28/2009	16:38	-0.26
12	302	10/29/2009	15:03	-0.27
13	303	10/30/2009	15:07	-0.26
14	304	10/31/2009	15:01	-0.27
15	305	11/1/2009	15:14	-0.26

Table 8 - Draft Measurements for the R/V D2

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
1	264	9/21/2009	15:15	-0.24
2	265	9/22/2009	14:25	-0.2
3	266	9/23/2009	15:25	-0.23
4	266	9/23/2009	17:11	-0.23
5	267	9/24/2009	14:12	-0.25
6	268	9/25/2009	14:36	-0.24
7	296	10/23/2009	15:02	-0.17
8	297	10/24/2009	14:46	-0.17
9	298	10/25/2009	13:37	-0.17
10	299	10/26/2009	14:44	-0.17
11	301	10/28/2009	14:52	-0.17
12	302	10/29/2009	14:48	-0.17
13	303	10/30/2009	14:47	-0.17
14	304	10/31/2009	14:41	-0.17
15	305	11/1/2009	14:39	-0.17

TIDES

All sounding data were initially reduced to mean lower low water (MLLW) using predicted tidal data. Predicted tidal data for a month long period, was assembled (for gauges 9419750 & 9431647) from the National Water Level Observation Program accessed through the NOAA tides and currents website (**http://tidesandcurrents.noaa.gov/**). A cumulative file for the gauges was updated monthly by appending the new data. It should be noted that predicted tides were used in the field for preliminary processing only. Refer to the Horizontal and Vertical Control Report for any additional tidal information.

On March 1, 2010, verified tide data was acquired from the National Water Level Observation Program accessed through the NOAA tides and currents website (**http://tidesandcurrents.noaa.gov/**). The tidal zoning file was developed and provided by NOAA. From March 1, 2010 to March 2, 2010, all sounding data were re-merged using CARIS HIPS and SIPS tide routine. Verified tidal data from the Crescent City, CA. (9419750) and the Port Orford, OR. (9431647) tidal stations were used for the final Navigation Base Surfaces and S-57 Feature files. Tidal stations were owned and operated by the NOAA's National Ocean Service through the National Water Level Observation Program.

VESSEL ATTITUDE: HEADING, HEAVE, PITCH, AND ROLL

Vessel heading and dynamic motion were measured by the Applanix (POS MV) 320 V4 on all vessels. The system calculated heading by inversing between two Trimble GPS generated antenna positions. An accelerometer block (the IMU), which measured vessel attitude, was mounted directly above the multibeam transducer. The operational accuracy specifications for this system, as documented by the manufacturer, are as follows:

Table 9 - POS MV Specifications

POS MV Accuracy	
Pitch and Roll	0.02°
Heading	0.02°
Heave	5% or 5-cm over 20 seconds

CALIBRATIONS

Multibeam

For all vessel and sonar configurations, patch tests were conducted to identify alignment errors (timing, pitch, heading, and roll) between the motion sensor and the multibeam transducer(s). Patch test calibration values used to correct all soundings for the survey are shown in **Table 10**.

Table 10 - Patch Test Results Summary

Patch Test Results						
Vessel	**Patch Test Day[1]**	**MB Sonar**	**Timing Error**	**Pitch Offset**	**Roll Offset**	**Azimuth Offset**
Pacific Star	JD165	7125 200 kHz (256 mode)	0.000	-0.400	-0.180	-2.200
	JD165	7125 400 kHz (256 mode)	0.000	-0.450	-0.330	-2.000
R2	JD165	7125 200 kHz (256 mode)	0.000	0.600	0.740	-1.200
	JD165	7125 400 kHz (256 mode)	0.000	1.550	0.770	-2.650
D2	JD165	8125	0.000	-2.900	1.840	1.900

Additional Sounding Techniques

None used.

[1] Julian day the actual test was done is listed. May be pre-dated in CARIS HVF to cover lines run before patch test.

D - Approval Sheet

Approval Sheet

For

H12130 & H12131

Standard field surveying and processing procedures were followed in producing this survey in accordance with the following documents:

M-M928-KR-09 Statement of Work
NOS Hydrographic Surveys Specifications and Deliverables, April 2009 Edition
Fugro Pelagos, Inc. Acquisition Procedures (2009-MBES_Acquisition_Procedures_R0);
Fugro Pelagos, Inc. Processing Procedures (2009-MBES_Processing_Procedures_R0)

The data were reviewed daily during acquisition and processing, and the survey is complete and adequate for its intended purpose.

This report has been reviewed and approved. All records are forwarded for final review and processing to the Chief, Pacific Hydrographic Branch.

Approved and forwarded,

Dean Moyles (ACSM Certificate N0. 226),
Senior Hydrographer
Fugro Pelagos, Inc.
July 6, 2010

X Dean Moyles Digitally signed by Dean Moyles
DN: cn=Dean Moyles, email=dmoyles@fugro.com, o=Fugro Pelagos, Inc., l=San Diego, CA
Date: 2010.07.02 17:49:37 -07'00'

Dean Moyles (ACSM Certificate N0. 226),
Senior Hydrographer

Appendix I – Equipment List and Software Versions

Equipment

Table 11 - Equipment List (Pacific Star, R2 & D2)

Description	Ast_SerialNumber
AML SV PLUS VELOCITY PROBE (MVP)	7523
AML SV PLUS VELOCITY PROBE (MVP)	7522
AML SV PLUS VELOCITY PROBE 1000DBAR	4431
AML SV PLUS VELOCITY PROBE 1000DBAR	4820
AML SV PLUS VELOCITY PROBE 1000DBAR	4656
AML SV PLUS VELOCITY PROBE 1000DBAR	5282
AML SV PLUS VELOCITY PROBE 1000DBAR	5283
AML SV PLUS VELOCITY PROBE 1000DBAR	5385
AML SV PLUS VELOCITY PROBE 1000DBAR	5354
AML SV PLUS VELOCITY PROBE 1000DBAR	5353
ANTENNA CELLULAR DUAL BAND 3DB	BGR602956
ANTENNA CELLULAR DUAL BAND 3DB	BGR602957
ANTENNA CELLULAR DUAL BAND 9DB	BGR602958
ANTENNA CELLULAR DUAL BAND 9DB	BGR602959
ANTENNA CELLULAR DUAL BAND 9DB	BGR602960
ANTENNA CELLULAR DUAL BAND 9DB	BGR602994
ANTENNA CELLULAR DUAL BAND 9DB	BGR602995
APPLANIX IMU 200	49
APPLANIX IMU 200	231
APPLANIX IMU 200	730
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2151
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2354
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2355
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2640
BROOKE OCEAN MVP-30 CONTROL I/O DECK UNIT	10597
BROOKE OCEAN MVP-30 SSFF (FISH)	10599
BROOKE OCEAN MVP-30 SSFF (FISH)	10598
BROOKE OCEAN MVP-30 TOW BLOCK	10596
BROOKE OCEAN MVP-30 WINCH	10595
CCTV CAMERA, DECK CAMERA	E030210380038
CCTV CAMERA, DECK CAMERA	E030210380040
CCTV DISPLAY	chb08504
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602489
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602562

Description	Ast_SerialNumber
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602603
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602604
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602605
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602606
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602608
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602832
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602834
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602835
DATA RADIO CELLULAR AMPLIFIER	323041
DATA RADIO CELLULAR AMPLIFIER	801245d7041199707
DATA TRANSFER HARD DRIVE	600037473
DATA TRANSFER HARD DRIVE	600037474
DATA TRANSFER HARD DRIVE	600037536
DATA TRANSFER HARD DRIVE	600037476
DATA TRANSFER HARD DRIVE	600037484
DATA TRANSFER HARD DRIVE	600037482
DATA TRANSFER HARD DRIVE	600037471
DATA TRANSFER HARD DRIVE	600037479
DATA TRANSFER HARD DRIVE	600037475
DATA TRANSFER HARD DRIVE	600037469
DATA TRANSFER HARD DRIVE	600037540
DONGLE ARCGIS ARCVIEW (ESRI)	37152209-VIEW1
DONGLE ARCGIS ARCVIEW (ESRI)	37152209-VIEW2
DONGLE BLUEMARBLE DESK	253857
DONGLE CARIS - NT (HIPS/SIPS)	CW9604871
DONGLE CARIS - NT (HIPS/SIPS)	CW9604873
DONGLE CARIS - NT (HIPS/SIPS)	CW9604665
DONGLE CARIS - NT (HIPS/SIPS)	CW9604894
DONGLE WINFROG	BGR602946
DONGLE WINFROG	BGR602947
DONGLE WINFROG	BGR602948
DONGLE WINFROG	BGR602949
ETHENET TELEMETRY , FROGLINK I/O	
GPS ANTENNA L1/L2	12561426
GPS ANTENNA L1/L2	60001982
GPS ANTENNA L1/L2	12697293
GPS ANTENNA L1/L2	60008160
GPS ANTENNA L1/L2	60124972
GPS ANTENNA L1/L2	60125052

Description	Ast_SerialNumber
GPS ANTENNA L1/L2	60186871
GPS ANTENNA L1/L2	60187495
GPS ANTENNA L1/L2 STARFIX SPOT	NZT070200049
GPS ANTENNA L1/L2 STARFIX SPOT	NZT070200047
GPS ANTENNA L1/L2 STARFIX SPOT	NZT07420009
GPS ANTENNA L1/L2 STARFIX SPOT	NZT07420011
GPS ANTENNA L1/L2 STARFIX SPOT	NZT08130058
GPS ANTENNA L1/L2 STARFIX SPOT	NZT08130051
GPS ANTENNA L1/L2 STARFIX SPOT	NZT08130069
GPS ANTENNA L1/L2 STARFIX SPOT	NZT08130062
GPS BEACON ANTENNA CSI MBL-3	9845-2643-0001
GPS BEACON ANTENNA CSI MBL-3	994-3051-0001
GPS BEACON ANTENNA CSI MBL-3	9932-4356-0002
GPS CSI CDA ANTENNA	0634-31116-0022
GPS CSI CDA ANTENNA	0640-31662-0020
GPS CSI CDA ANTENNA	0640-31662-0017
GPS CSI CDA ANTENNA	0748-5628-0162
GPS CSI MBX-3 COASTGUARD RECEIVER	9834-2211-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	0042-7227-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9833-2166-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9834-2211-0002
GPS CSI MBX-3 COASTGUARD RECEIVER	9920-3754-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9913-3442-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	0314-11467-0001
GPS RECEIVER L1/L2 STARFIX XP/HP	NBVO7080003
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07080024
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07120016
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07120002
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV08200008
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV08200006
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV08200007
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV08200005
GRAB SAMPLER	
GRAB SAMPLER	
GRAB SAMPLER	
INMARSAT PHONE ANTENNA CONTROL UNIT DAC-2202	TBA1
INMARSAT PHONE MODEM CI1300 IDU	0678
INMARSAT PHONE MOUNTING MAST	BGR602916
INMARSAT PHONE SEATEL 6006KU-7 RADOME	MRHS0088F

Description	Ast_SerialNumber
INMARSAT PHONE TERMINAL MOUNTING STRIP	TBA2
LAPTOP PC	4WJ4R51
LAPTOP PC	hb2pbg1
LAPTOP PC	462H691
MONITOR FLATSCREEN (1600X1200) LCD	mx0c9536466346ci4e6l
MONITOR FLATSCREEN (1600X1200) LCD	s7y301944ga
MONITOR FLATSCREEN (1600X1200) LCD	s7y301942ga
MONITOR FLATSCREEN (1600X1200) LCD	s7y301948ga
MONITOR FLATSCREEN (1600X1200) LCD	s7y301954ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303878ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303872ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303873ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303881ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303816ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303883ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303880ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303874ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303882ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303875ga
MONITOR FLATSCREEN (1600X1200) LCD	S87311453GA
MONITOR FLATSCREEN (1600X1200) LCD	S87311390GA
MONITOR FLATSCREEN (1600X1200) LCD	S87311381GA
MONITOR FLATSCREEN (1920X1200) LCD	84104171NA
MONITOR FLATSCREEN (1920X1200) LCD	S84104409NA
MONITOR FLATSCREEN (1920X1200) LCD	S84104440NA
MONITOR FLATSCREEN (1920X1200) LCD	S84104419NA
MONITOR FLATSCREEN (1920X1200) LCD	S84104041NA
MONITOR FLATSCREEN (1920X1200) LCD	87106354NA
NETWORK ATTACHED STORAGE	NA0000000413215
NETWORK ATTACHED STORAGE	30012669
NETWORK ATTACHED STORAGE	PMC 643620109071
NETWORK ATTACHED STORAGE (SMART) NETAPP 3050	JW0000000071173
NETWORK HUB/SWITCH 8 PORT MANAGED	FOC1234U1WQ
NETWORK HUB/SWITCH 8 PORT MANAGED	FOC1229U620
PRINTER LASER	CNJC84X053
RESON NAVISOUND SVP 70	2007073
RESON NAVISOUND SVP 70	4506001
RESON SEABAT 7125 200KHZ PROJECTOR	0408001
RESON SEABAT 7125 200KHZ PROJECTOR	4408352

Description	Ast_SerialNumber
RESON SEABAT 7125 400KHZ PROJECTOR	5006392
RESON SEABAT 7125 400KHZ PROJECTOR	5006396
RESON SEABAT 7125 RECEIVE ARRAY	4107007
RESON SEABAT 7125 RECEIVE ARRAY	2507038
RESON SEABAT 71-P LCU	1515004
RESON SEABAT 71-P LCU	1515008
RESON SEABAT 71-P PROCESSOR	4707090
RESON SEABAT 71-P PROCESSOR	4707082
RESON SEABAT 8111 RECEIVER ARRAY	0100056
RESON SEABAT 8111 TRANSCEIVER	23745
RESON SEABAT 8111 TRANSMIT ARRAY	2104019
RESON SEABAT 8125 TRANSDUCER	0802100
RESON SEABAT PROCESSOR RESON 81-P	23279
RESON SEABAT PROCESSOR RESON 81-P	36746
RESON SVP-C TOPSIDE (8125)	74548
ROUTER	jmx0623k950
ROUTER	68-2618-01
SLIP RING IEC	3259-0601
SLIP RING IEC	4103-0000-0702
SLIP RING IEC	9-25-87-K714
TOOL KIT	
UHF ANTENNA	
UHF ANTENNA	
UHF ANTENNA	
UHF ANTENNA	
UHF, radio modem	075004322
UHF, radio modem	075004326
UHF, radio modem	075004327
UHF, radio modem	075004328
UPS UNIT < 3KVA	9507CY00M535701502
UPS UNIT < 3KVA	9507CY00M535701508
UPS UNIT < 3KVA	9507CY00M535701488
UPS UNIT < 3KVA	9507cy0om535701448
UPS UNIT < 3KVA	9507cy0om535701489
UPS UNIT < 3KVA	9507cy0om535701496
UPS UNIT < 3KVA	9721BY0SM678800096
UPS UNIT < 3KVA	9721BY0SM678800227
UPS UNIT > 3KVA	9536ALCSM583100588
UPS UNIT > 3KVA	9642ALCSM653400138

Description	Ast_SerialNumber
UPS UNIT > 3KVA	9642ALCSM653400264
UPS UNIT > 3KVA	9651ALCSM653400151
UPS UNIT > 3KVA	9651ALCSM653400159
UW COLOUR CAMERA	v08b00647ntsc
UW COLOUR CAMERA	V08B20769NTSC
VHF ANTENNA	BGR602770
VHF BASE STATION	44003775
VHF BASE STATION	1207629
WINCH (MVP-30) SPARES KIT	
WINCH HYDRAULIC MEDIUM / SMALL TOW	101-1008-009
WINCH HYDRAULIC MEDIUM TOW	
COMPUTER DELL PC (PROCESSING)	21DFQB1
COMPUTER DELL PC (PROCESSING)	4454KC1
COMPUTER DELL PC (PROCESSING)	6FS5ZC1
DATA SYSTEMS	
DONGLE CARIS - NT (HIPS/SIPS)	CW9604869
DONGLE CARIS - NT (HIPS/SIPS)	CW9604872
DONGLE CARIS - NT (HIPS/SIPS)	CW9604894
DONGLE CARIS - NT (HIPS/SIPS)	CW9604705
DONGLE CARIS - NT (HIPS/SIPS)	CW9605434
DONGLE C-MAP	ET30021
DONGLE POS GPS	7212
DONGLE POS GPS	7346
DONGLE POS PAC	464-1650
DONGLE POS PAC	495-1740
MONITOR FLATSCREEN (1920X1200) LCD	CN-0CC3024663367B21RS
MONITOR FLATSCREEN (1920X1200) LCD	mx0ju436742628692wcs
MONITOR FLATSCREEN (1920X1200) LCD	mx0ju436742628692tns
MONITOR FLATSCREEN (1920X1200) LCD	mx0ju436742628692tks
MONITOR FLATSCREEN (1920X1200) LCD	mx0ju436742628692wrs
MONITOR FLATSCREEN (1920X1200) LCD	mx0ju436742628692tds

Software

Table 12 - Software List (Pacific Star, R2, D2, & Processing Center)

Software Package	Version	Service Pack	Hotfix
Fugro Pelagos Winfrog Multibeam	3.08.44.04	N/A	N/A
Fugro Pelagos MBSurvey Tools	2.00.25.00	N/A	N/A
Fugro Pelagos POSMVLogger	1.0	N/A	N/A
CARIS HIPS/SIPS	6.1	2	1-4 & 6-8
CARIS HIPS/SIPS	7.0	1	1-5
CARIS Notebook	3.1	0	1-2
CARIS Bathy DataBASE	2.3	0	1-16
ESRI ArcGIS	9.3.1	N/A	N/A
Applanix POS MV V4 Controller	3	N/A	N/A
Applanix POSPac MMS	5.3	1	N/A
IVS Fledermaus	6.7.0	N/A	N/A
Nobeltec Tides and Currents	3.5.107	N/A	N/A
Microsoft Office	2007 Professional	N/A	N/A
Microsoft Windows	XP Professional	3	N/A
Helios Software Solutions Textpad	5.2.0	N/A	N/A
IrfanView	3.98	N/A	N/A

Appendix II – Vessel Descriptions

F/V Pacific Star

The F/V Pacific Star (**Figure 5**), a former Bering Sea crab fishing vessel, was modified to accommodate a survey crew, acquisition hardware, and survey launches. Living quarters and office space containers were installed on the back deck. Davits previously used on the R/V Davidson were installed near the aft end of the vessel to lift and deploy the R2 and D2 survey launches. Access doors and infrastructure were built to facilitate access to the launches.

A Reson Seabat 7125 multibeam sonar was hull mounted near the best estimate of the vessel's center of gravity, approximately midship. A drop keel was attached to the keel and protected the sonar heads forward by a crescent shaped skid (**Figure 8**). The inertial measurement unit (IMU) accelerometer package for a POS MV was installed inside the hull almost directly above the Reson 7125.

Table 13 - Vessel Specifications (F/V Pacific Star)

SURVEY VESSEL F/V PACIFIC STAR	
Owner	Pacific Star Fisheries, LLC
Official Number	556510
Length	162'
Breadth	38'
Depth	14'
Max Draft	16'
BHP Main Engines	3,000 combined BHP (1500 ea) Two Electromotive Diesels
Gross Tonnage (US)	194
Fresh Water Capacity	24,399 Gallons
Fuel Capacity	90,112 Gallons

Figure 5 – F/V Pacific Star

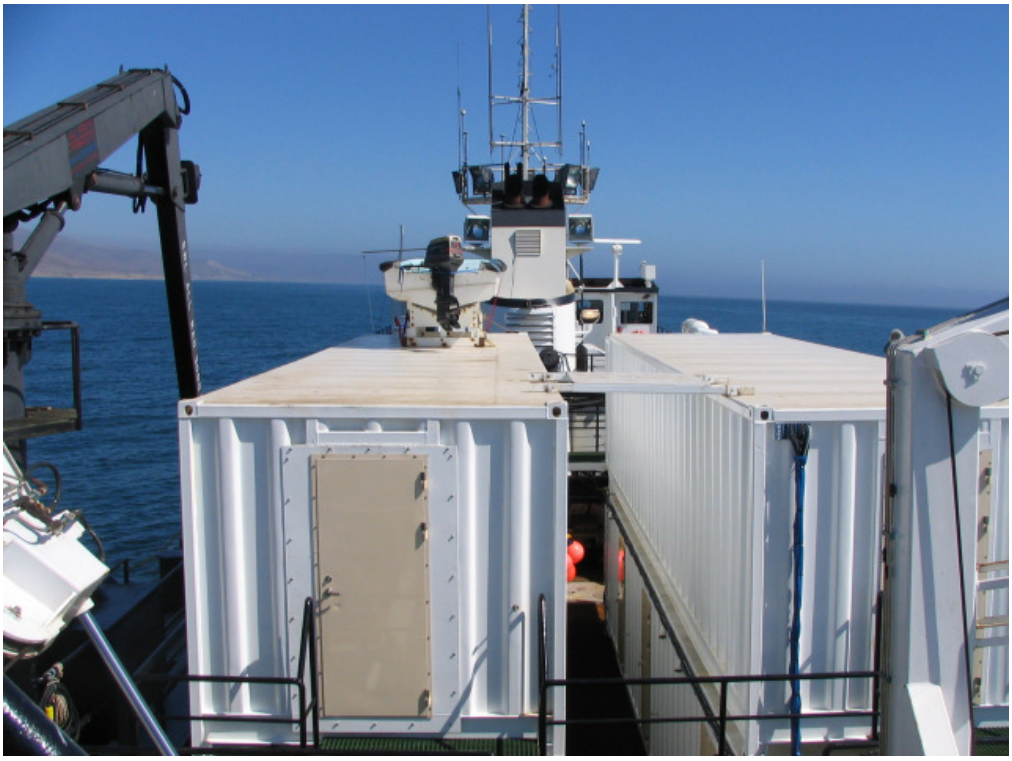


Figure 6 – F/V Pacific Star Office Containers

Figure 7 – F/V Pacific Star Davit Launch System

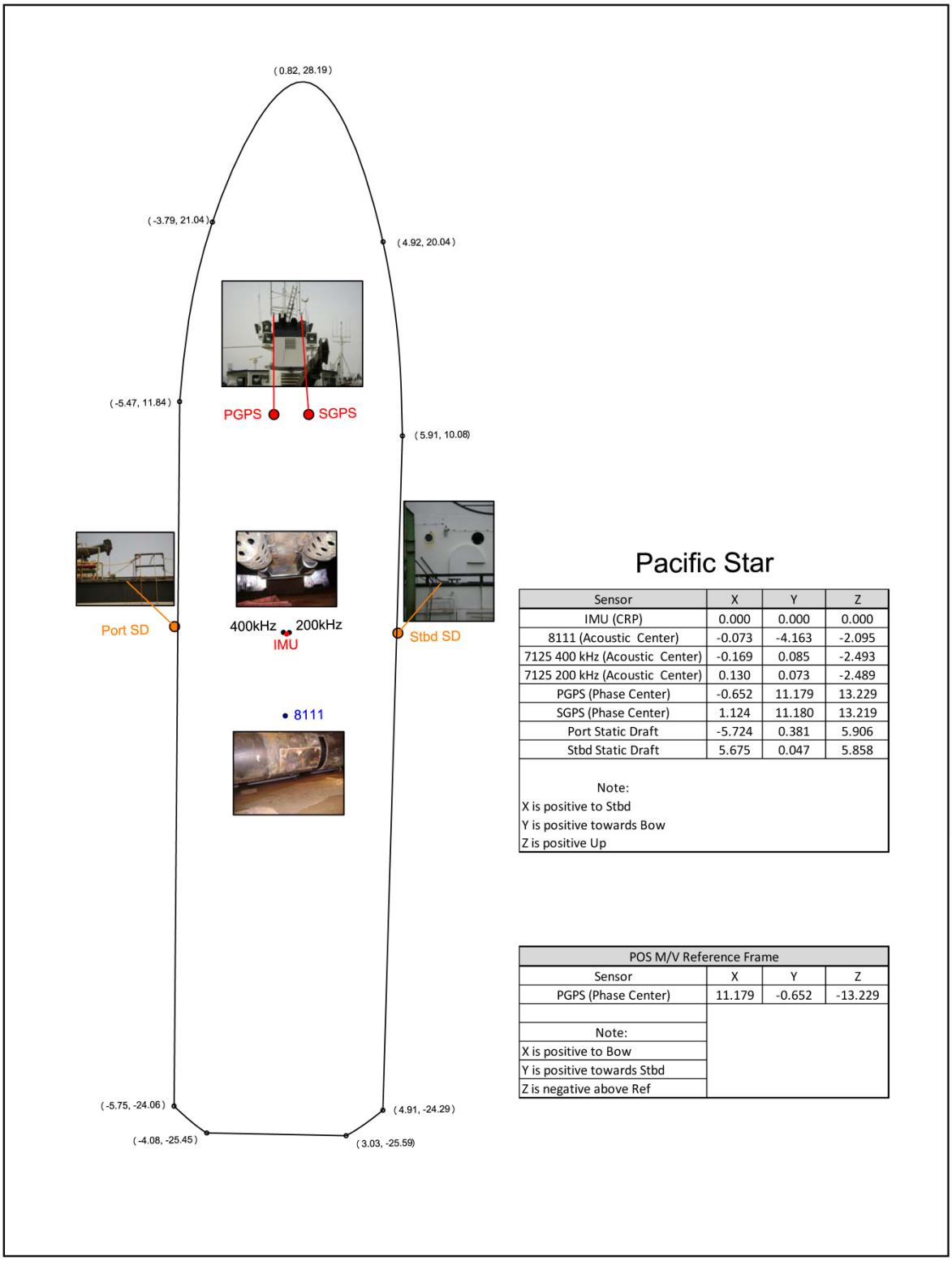
Figure 8 – F/V Pacific Star Drop Keel with 7125 and 8111 Sonar Heads

Two Trimble L1/L2 antennas were mounted above and forward from the sonar. Offset 3.4 meters port-starboard from each other, these provided GPS data to the POS MV for position, attitude, and heading computations. The port side antenna functioned as the POS MV master antenna; the starboard side antenna functioned as the POS MV secondary.

A Brooks Ocean MVP-30 system using an AML Smart Probe was installed and used off the stern to collect sound velocity profiles in shallow water. An AML Smart Probe with on a standard winch setup was used off the stern for deeper water and as a backup to the MVP-30.

Draft measurement tabs were installed at convenient measurement stations on both the port and starboard sides of the vessel, in line with the CRP and Reson 7125.

Offset values for the CRP to the sonar and waterline were applied to the data in CARIS HIPS as specified in the HIPS vessel file (HVF). Offsets between the GPS antennas and the CRP were applied internally by the POS MV by entering a GPS lever arm offset. Vessel offsets used are shown in the offset diagram (**Figure 9**).



Pacific Star

Sensor	X	Y	Z
IMU (CRP)	0.000	0.000	0.000
8111 (Acoustic Center)	-0.073	-4.163	-2.095
7125 400 kHz (Acoustic Center)	-0.169	0.085	-2.493
7125 200 kHz (Acoustic Center)	0.130	0.073	-2.489
PGPS (Phase Center)	-0.652	11.179	13.229
SGPS (Phase Center)	1.124	11.180	13.219
Port Static Draft	-5.724	0.381	5.906
Stbd Static Draft	5.675	0.047	5.858

Note:
X is positive to Stbd
Y is positive towards Bow
Z is positive Up

POS M/V Reference Frame			
Sensor	X	Y	Z
PGPS (Phase Center)	11.179	-0.652	-13.229

Note:
X is positive to Bow
Y is positive towards Stbd
Z is negative above Ref

Figure 9 - Pacific Star Offset Diagram

R/V R2

The R/V R2 (**Figure 10**), a Pacific Star launch, was modified to accommodate a survey crew and acquisition hardware. The keel was cut just aft of mid-ship and a Reson 7125 multibeam sonar was installed. A conical cowling protected the sonar head forward and aft by way of a crescent shaped skid. The accelerometer package for a POS MV was mounted in the hull of the vessel just over the 7125 multibeam transducer head.

Two Trimble L1/L2 antennas were mounted above the 7125 and accelerometer for positioning and heading. The two POS MV antennas were offset 1.0m to the port and starboard. The port side antenna (L1/L2) functioned as the POS MV master antenna; the starboard side antenna functioned as the POS MV secondary.

The AML Smart Probe SV&P sensors were deployed from an A-Frame on the stern using a small hydraulic winch.

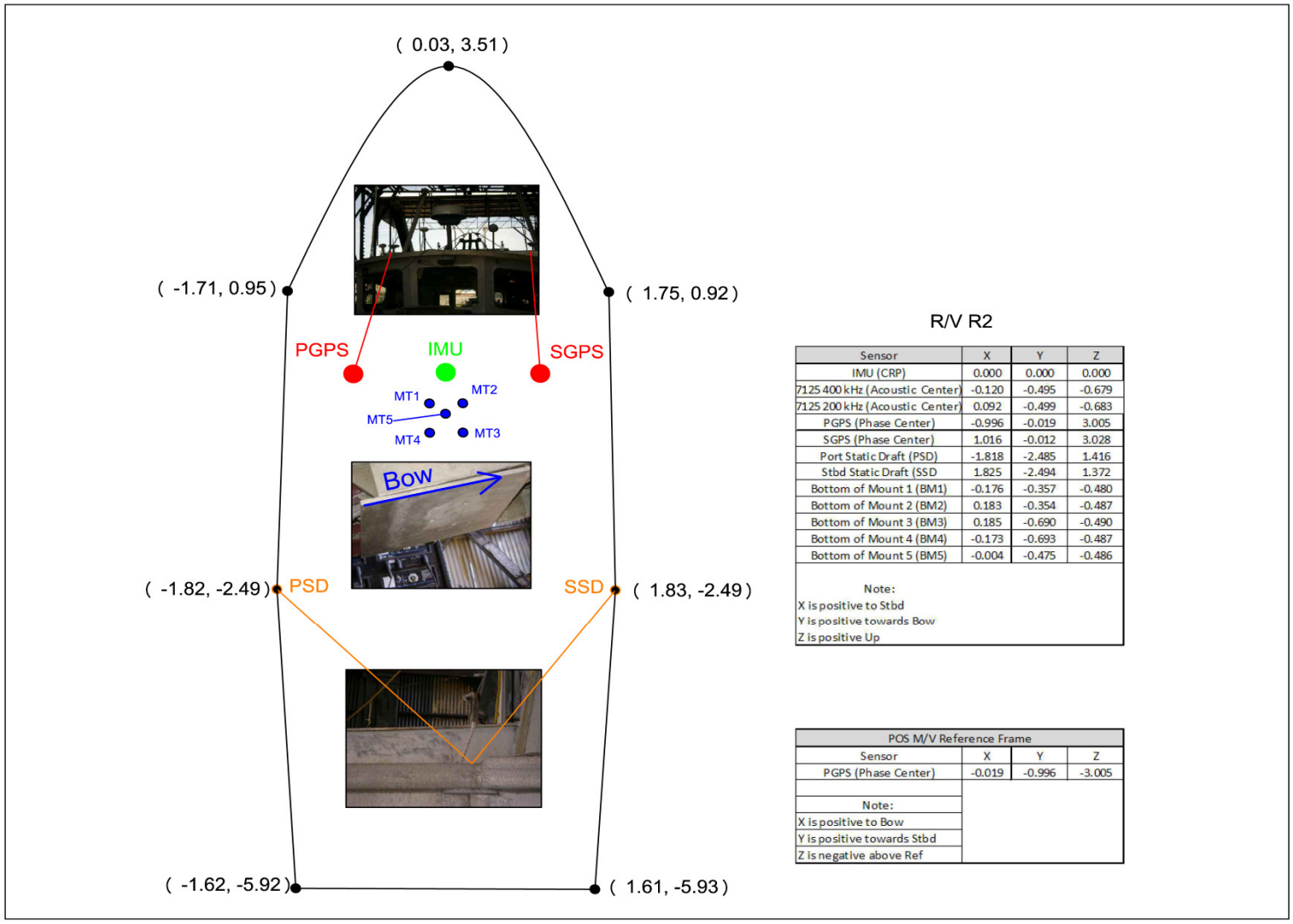
Draft measurement points were indentified at convenient measurement stations on both the port and starboard sides of the vessel, aft of the CRP and Reson 7125.

Offset values were applied to the data in CARIS HIPS as specified in the vessel configuration file (VCF). Vessel offsets used are shown in the offset diagram (**Figure 11**). Note that the VCF does not contain navigation offsets because the position provided by the POS MV is already corrected to the CRP.

Figure 10 - R/V R2

Table 14 - Vessel Specifications (R2)

SURVEY LAUNCH R/V R2	
Owner	Stabbert Maritime Yacht & Ship
Official Number	623241
Year Built	1980/1982
Length	28.9’
Beam	12’
Draft	5.7’
Gross Tonnage	15
Net Tonnage	13
Mechanical Power	Caterpillar 3208
Electrical	Northern Lights



R/V R2

Sensor	X	Y	Z
IMU (CRP)	0.000	0.000	0.000
7125 400 kHz (Acoustic Center)	-0.120	-0.495	-0.679
7125 200 kHz (Acoustic Center)	0.092	-0.499	-0.683
PGPS (Phase Center)	-0.996	-0.019	3.005
SGPS (Phase Center)	1.016	-0.012	3.028
Port Static Draft (PSD)	-1.818	-2.485	1.416
Stbd Static Draft (SSD	1.825	-2.494	1.372
Bottom of Mount 1 (BM1)	-0.176	-0.357	-0.480
Bottom of Mount 2 (BM2)	0.183	-0.354	-0.487
Bottom of Mount 3 (BM3)	0.185	-0.690	-0.490
Bottom of Mount 4 (BM4)	-0.173	-0.693	-0.487
Bottom of Mount 5 (BM5)	-0.004	-0.475	-0.486

Note:
X is positive to Stbd
Y is positive towards Bow
Z is positive Up

POS M/V Reference Frame			
Sensor	X	Y	Z
PGPS (Phase Center)	-0.019	-0.996	-3.005
Note:			
X is positive to Bow			
Y is positive towards Stbd			
Z is negative above Ref			

Figure 11 - R2 Offset Diagram

R/V D2

The R/V D2 (**Figure 12**), a Pacific Star launch, was modified to accommodate a survey crew and acquisition hardware. The keel was cut just aft of mid-ship and Reson 8125 multibeam sonar was installed. A conical cowling protected the sonar head forward and aft by way of a crescent shaped skid. The accelerometer package for a POS MV was mounted in the hull of the vessel just over the 8125 multibeam transducer head.

Two Trimble L1/L2 antennas were mounted above the 8125 and accelerometer for positioning and heading. The two POS MV antennas were offset 1.0m to the port and starboard from the IMU. The port side antenna (L1/L2) functioned as the POS MV master antenna; the starboard side antenna functioned as the POS MV secondary.

The AML Smart Probe SV&P sensors were deployed from an A-Frame on the stern using a small hydraulic winch.

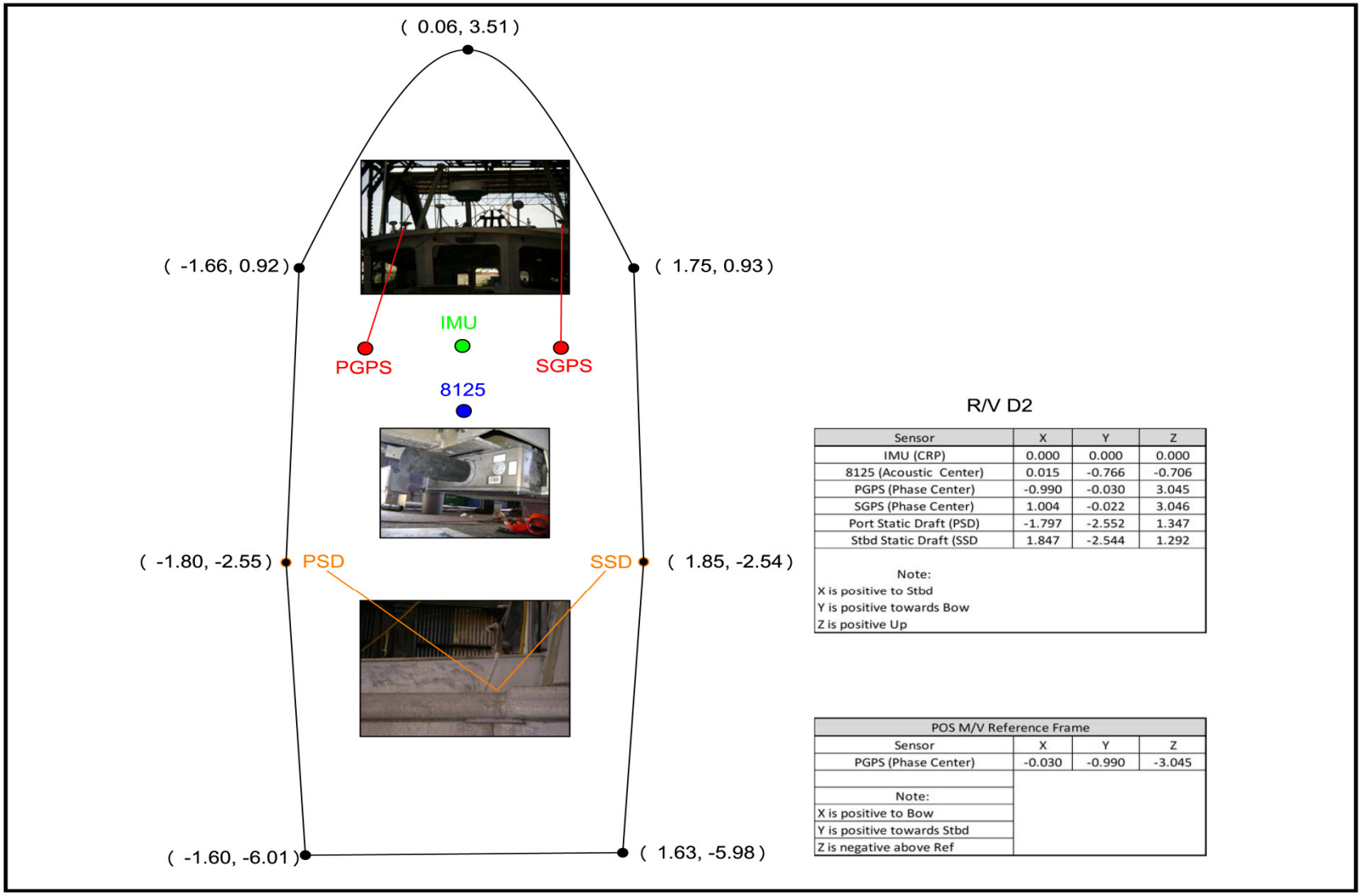
Draft measurement points were indentified at convenient measurement stations on both the port and starboard sides of the vessel, aft of the CRP and Reson 8125.

Offset values were applied to the data in CARIS HIPS as specified in the vessel configuration file (VCF). Vessel offsets used are shown in the offset diagram (**Figure 13**). Note that the VCF does not contain navigation offsets because the position provided by the POS MV is already corrected to the CRP.

Figure 12 - R/V D2

Table 15 - Vessel Specifications (D2)

SURVEY LAUNCH R/V D2	
Owner	Stabbert Maritime Yacht & Ship
Official Number	647782
Year Built	1980/1982
Length	28.9’
Beam	12’
Draft	5.7’
Gross Tonnage	15
Net Tonnage	13
Mechanical Power	Caterpillar 3208
Electrical	Northern Lights



R/V D2

Sensor	X	Y	Z
IMU (CRP)	0.000	0.000	0.000
8125 (Acoustic Center)	0.015	-0.766	-0.706
PGPS (Phase Center)	-0.990	-0.030	3.045
SGPS (Phase Center)	1.004	-0.022	3.046
Port Static Draft (PSD)	-1.797	-2.552	1.347
Stbd Static Draft (SSD	1.847	-2.544	1.292

Note:
X is positive to Stbd
Y is positive towards Bow
Z is positive Up

POS M/V Reference Frame			
Sensor	X	Y	Z
PGPS (Phase Center)	-0.030	-0.990	-3.045

Note:
X is positive to Bow
Y is positive towards Stbd
Z is negative above Ref

Figure 13 - D2 Offset Diagram

Appendix III – Calibration Reports

All Calibration Reports can be found under the Appendix_III (SVP_Calibrations) directory.